

# Non-operative management (NOM) of blunt hepatic trauma: 80 cases

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## ABSTRACT

**BACKGROUND:** Liver is the most frequently injured organ upon abdominal trauma. We present a group of patients with blunt hepatic trauma who were managed without any invasive diagnostic tools and/or surgical intervention.

**METHODS:** A total of 80 patients with blunt liver injury who were hospitalized to the general surgery clinic or other clinics due to the concomitant injuries were followed non-operatively. The normally distributed numeric variables were evaluated by Student's t-test or one way analysis of variance, while non-normally distributed variables were analyzed by Mann-Whitney U-test or Kruskal-Wallis variance analysis. Chi-square test was also employed for the comparison of categorical variables. Statistical significance was assumed for  $p < 0.05$ .

**RESULTS:** There was no significant relationship between patients' Hgb level and liver injury grade, outcome, and mechanism of injury. Also, there was no statistical relationship between liver injury grade, outcome, and mechanism of injury and ALT levels as well as AST level. There was no mortality in any of the patients.

**CONCLUSION:** During the last quarter of century, changes in the diagnosis and treatment of liver injury were associated with increased survival. NOM of liver injury in patients with stable hemodynamics and hepatic trauma seems to be the gold standard.

**Key words:** Liver; nonoperatif management; trauma.

## INTRODUCTION

Blunt trauma is one of the most serious and most common cause of death in youth.<sup>[1]</sup> Specifically, liver is the most frequently injured organ during abdominal trauma.<sup>[2]</sup> Advances in imaging modalities such as ultrasound and computed tomography, interventional radiology, critical care, and the introduction of damage control surgery during the past two decades have greatly influenced the diagnosis and treatment algorithm in trauma surgery.<sup>[3]</sup> During the last century, the

management of blunt force trauma to the liver has changed from mainly operative intervention, to the current practice of selective operative and non-operative management (NOM).<sup>[4]</sup> NOM of blunt liver injuries has become the standard for care patients with stable hemodynamics, which account for approximately 85% of all those with blunt hepatic trauma.<sup>[5]</sup> Avoidance, if at all costs, of a laparotomy with its short and long term risks is of great benefit to the patient.<sup>[6]</sup> We present a group of patients with blunt hepatic trauma that were managed without any invasive diagnostic tools and/or surgical intervention.

## MATERIALS AND METHODS

### Study Sample

Patients who were admitted to our ED with blunt trauma between January 2002 and December 2012 were screened for radiological diagnosis of liver injury and were collected retrospectively. The patients with hemodynamic instability, altered level of consciousness, penetrant liver injury, less than 16 years old, and needed invasive and/or surgical intervention were all excluded from this study. A total of 80 patients with

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**Table I.** American Association for the Surgery of Trauma grading scale for hepatic injuries

Liver injury grade	Sub-capsular hematoma	Laceration
Grade I	<10% surface area	<1 cm in depth
Grade II	10-50% surface area	1-3 cm
Grade III	>50% or >10 cm	>3 cm
Grade IV	25-75% of a hepatic lobe	
Grade V	>75% of a hepatic lobe	
Grade VI	Hepatic avulsion	

blunt liver injury that were hospitalized to the general surgery clinic or other clinics due to concomitant injuries were followed non-operatively.

### Collection of Data and Definitions

Baseline characteristics of patients with blunt liver injury such as age, gender, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mechanism of injury, preferred imaging modality, liver injury grading scale according to American Association for the Surgery of Trauma (AAST) (Table I), and patient hospitalization were recorded. Blood samples drawn at admission such as serum Hgb, AST, and ALT levels were recorded. Blunt liver injury was defined as radiological findings on abdominal ultrasonography and/or computed tomography (CT) with no evidence of penetrant injury. Hemodynamic stability was defined as systolic blood pressure above 90 mmHg, heart rate below 110/minute, and normal level of consciousness on arrival or during follow-up. [7] NOM consisted of closely monitoring with repeated clinical assessment including the evaluation of vital signs such as SBP, HR, temperature, and fluid balance with estimating input and output of fluids in the body and measurement of Hgb and hematocrit four times daily for the first 48 hours and later twice a day until the end of the 5th day follow-up.

### Statistical Analysis

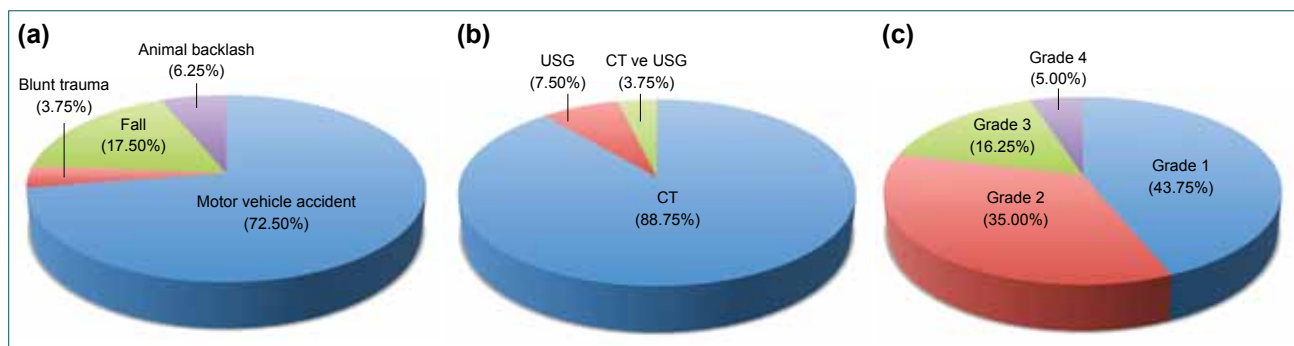
Statistical Package for Social Sciences software (SPSS 19.0, Chicago, IL, USA) was used for statistical analysis. Continuous

variables were expressed as mean±standard deviation values, whereas categorical variables were presented as percentages. The differences between normally distributed numeric variables were evaluated by Student’s t-test or one way analysis of variance, while non-normally distributed variables were analyzed by Mann-Whitney U-test or Kruskal-Wallis variance analysis as appropriate. Chi-square (X<sup>2</sup>) test was employed for the comparison of categorical variables. Statistical significance was assumed for p<0.05.

### RESULTS

Of the cases studied, 55 (69%) were male and 25 (31%) were female. The mean age was 36.49±18.14 years (min=15, max=85). The most common mechanism of injury (n=58; 72.5%) was motor vehicle accident and the most commonly preferred imaging modality (n=71; 89%) was abdominal CT. Distribution of patients according to their mechanism of trauma and preferred imaging modality is shown in Figure 1a and Figure 1b, respectively. The most frequently graded liver injury for the patients tested were grades I and II (n=35; 44% and n=28; 35%, respectively) (Figure 1c).

The mean systolic blood pressure was 113.98±7.202 mmHg (min=100, max=130), the mean diastolic blood pressure was 72.05±8.409 mmHg (min=40, max=80), and the average heart rate was 85.68±5.811 (min=72, max=100) per minute. Hgb values were statistically different between male and females. The average value for women was 12.3±2.42 (min=8.1



**Figure 1.** (a) Mechanism of injury. (b) Radiology. (c) Lesions.

max=15.9) and for men was  $13.61 \pm 1.5$  (min=9.8 max=17.5). There was no difference in AST and ALT between genders, ALT:  $287.54 \pm 353.91$  (min=12 max=2248) and AST:  $286.48 \pm 305.68$  (min=11 max=1522). There was no significant relationship between patient Hgb level and liver injury grade, outcome, and mechanism of injury ( $p=0.283$ ;  $p=0.87$ ,  $p=0.586$ , respectively). Also, there was no relationship between liver injury grade, outcome and mechanism of injury, and ALT levels ( $p=0.592$ ;  $p=0.262$ ;  $p=0.811$ , respectively) as well as AST levels ( $p=0.112$ ;  $p=0.127$ ;  $p=0.822$ , respectively). Of the cases, 62 were admitted to general surgery clinic and discharged with recovery. Three patients were followed in different clinics because of additional problems. Two patients were discharged from thoracic surgery clinic and one from orthopedic clinic with healing. Twelve patients were transferred to other clinics from general surgery after treatment (six to orthopedic, three to thoracic surgery, two to intensive care unit and one to neurosurgery clinics). Three cases underwent an operation in the following days of which two had spleen laceration and one had small bowel perforation. There was no mortality in any of the patients.

## DISCUSSION

Diagnostic peritoneal lavage was the most important diagnostic procedure for liver trauma in the last quarter of the twentieth century. This test had a low complication rate and high accuracy. Even so, it was not possible to determine the degree of liver injury in the absence of intra-abdominal bleeding.<sup>[8,9]</sup> In the early 1990s with the introduction of focused assessment with sonography for trauma (FAST), the detection of free fluid in the abdomen was more easily observed. The main disadvantage of this method was the insufficiency of detecting bleeding sites and degree of liver injury. Computed tomography (CT) which was introduced from the second half of the 1990s, was very useful for surgeons to identify the degree of liver injury in addition to the determination of site and amount of bleeding.<sup>[10,11]</sup>

Our experience of non-operative treatment in patients with liver injury has increased with this technological advancement in the last 25 years. Based on this information, non-operative treatment of patients with stable hemodynamics and blunt liver trauma seems to be the better treatment option. Recent studies have showed that success rate ranges from 87% to 98%.<sup>[12]</sup> In our study, the percentage was 96.25% with CT demonstrating great effectiveness in the detection of bleeding as well as bleeding site and degree of injury. CT was also very useful in the determination of the most accurate treatment method and in the follow-up of the patients in the clinic.

In patients with non-operative liver trauma, is it possible that other intra-abdominal injuries may be overlooked with CT follow-up? Although Miller et al.<sup>[13]</sup> showed that the rate of failure was 1.1%, the incidence of bowel or diaphragm injuries in association with spleen or liver injury in patients under-

going laparotomy after blunt trauma was reported between 0.5% and 12% in the literature.<sup>[13,14]</sup> Yanar et al.<sup>[15]</sup> reported one patient for whom NOM failed because of the mesenteric laceration. In our study, one patient (1.25%) was overlooked and had to be operated on due to deterioration of the general condition during the clinical follow-up and small bowel injury was detected.

The different failures have been described in various studies. Velmahos et al. showed that failure of NOM occurred in one-third of patients for reasons other than the solid organ injury.<sup>[16]</sup> In another study, Holmes et al.<sup>[17]</sup> reported that bicycle crashes were associated with increased risk of NOM failure. They also found that the rate of NOM failure was 10.9% to 38.2% in isolated organ injury but 54.4% to 70.0% in multiple organ injury. Malhotra et al.<sup>[18]</sup> managed non-operatively 4 of (36%) the 11 patients with high-grade injury to both the liver and spleen successfully. Although the number is small, this may support the contention that selected patients with higher-grade injuries to multiple solid organs can be managed non-operatively. Yanar et al.<sup>[15]</sup> reported that multiplicity of solid organ injury is not a predictive marker of NOM failure, and subset analysis of organ combination revealed no association with NOM failure. In our study, 17 patients (21.25%) with grade III and IV injury were treated with NOM successfully. Of the 3 patients with NOM failure, there was grade II injury in two patients and grade I injury in one patient. Two of these patients were operated on due to spleen laceration and the other patient was operated due to small bowel perforation. The low number of patients with NOM failure in our study makes it difficult to explain the factors that cause this condition. The deterioration of hemodynamic stability in these three patients led us to immediate surgery. Some authors have stated that hemodynamic instability is more important than grading of liver injury in children with blunt liver trauma. In addition, a decrease in hemoglobin value and deterioration of liver function tests was found to be the reason for emergency surgery in some studies.<sup>[19]</sup> In our study, decreases in hemoglobin values in two patients with splenic laceration lead us to move immediate surgery. Hemoglobin values in other follow-up patients remained stable.

The frequency of delayed bleeding is higher in splenic injury than in hepatic injury, and this may decrease the success rate of NOM.<sup>[15]</sup> Yanar et al. reported that among the four patients for whom NOM failed because of delayed bleeding, two grade IV splenic injuries, one grade II splenic injury, and one grade IV renal injury were detected during the operation.<sup>[15]</sup> In our study, NOM failed in two patients because of grade II splenic injury.

Shapiro et al.<sup>[20]</sup> stated that NOM of neurologically impaired, patients with stable hemodynamics, blunt injuries of the liver, spleen, or kidney is commonly practiced and is successful in greater than 90% of cases. In conclusion, changes during the last quarter of century in the diagnosis and treatment of

liver injury are associated with increased survival. NOM in patients with stable hemodynamics, hepatic trauma seems to be the gold standard. Although CT is important for follow-up and treatment of patients with blunt liver trauma, it should be correlated with hemodynamic instability.

Conflict of interest: None declared.

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## KLİNİK ÇALIŞMA - ÖZET

### Künt karaciğer travmalarında cerrahi dışı yaklaşım: 80 olgu

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**AMAÇ:** Karaciğer karın travmalı hastalarda en sık yaralanan solid bir organdır. Bu çalışmada, tedavisinde ve takibinde herhangi bir invaziv tanısal girişim ya da cerrahi girişim yapılmayan bir grup künt karaciğer travmalı hasta değerlendirildi.

**GEREÇ VE YÖNTEM:** Genel cerrahi kliniğine yatırılan ve bunun yanısıra ek yaralanmaları sebebiyle diğer kliniklere yatırılıp genel cerrahi tarafında bu kliniklerde takibi yapılan toplam künt karaciğer yaralanması olan 80 hasta cerrahi yapılmadan izlendi. Normal dağılım gösteren veriler Student's t-testi veya tek yönlü varyans analizi ile değerlendirildi. Anormal dağılım gösteren veriler ise Mann-Whitney U-testi veya Kruskal-Wallis varyans analizi ile incelendi. Kategorik veriler ki-kare testi ile analiz edildi ve p<0.05 istatistiksel olarak anlamlı kabul edildi.

**BULGULAR:** Takip edilen hastaların hemoglobin düzeyleri, karaciğer yaralanma derecesi ve taburcu olması ile yaralanma mekanizması arasında istatistik olarak anlamlı bir ilişki bulunamadı. Aynı zamanda karaciğer yaralanması derecesi, taburcu olması ve yaralanma mekanizması ile ALT ve AST değerleri arasında da istatistik olarak anlamlı bir ilişki yoktu. Hastaların hiçbirinde ölüm olmadı.

**TARTIŞMA:** Karaciğer yaralanmasının tanı ve tedavisinde son 25 beş yıl boyunca hayatta kalma süresini uzatan değişiklikler olmuştur. Cerrahi dışı yaklaşım hemodinamik olarak stabil olan karaciğer travmalı hastaların takip ve tedavisinde altın standart olarak görülmektedir.

**Anahtar sözcükler:** Karaciğer; nonoperatif yaklaşım; travma.

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